WLHS / Chem / Monson

— KEY —

PROBLEM SET: Limiting Reactants

1) Use the following chemical equation: $2\,H_2 + O_2 \rightarrow 2\,H_2O$

A) Balance the equation.

B) Identify the limiting reactant when 1.22 g of O_2 reacts with 1.05 g of H_2 to produce water.

$1.22\,g\,O_2 \times \frac{1\,mol\,O_2}{32.0\,g} \times \frac{2\,mol\,H_2}{1\,mol\,O_2} \times \frac{2.0\,g}{1\,mol\,H_2} = 0.153\,g\,H_2$ needed (excess)

O_2 is L.R.

C) What mass of water will be formed in the reaction?

$1.22\,g\,O_2 \times \frac{1\,mol\,O_2}{32.0\,g} \times \frac{2\,mol\,H_2O}{1\,mol\,O_2} \times \frac{18.0\,g}{1\,mol\,H_2O} = 1.37\,g\,H_2O$

D) What mass of the excess reagent will be left over / unused?

$1.05\,g - 0.15\,g$ used $= 0.90\,g\,H_2$ left

2) Use the following chemical equation: $Fe + S \rightarrow FeS$

A) Balance the equation. ✓

B) Identify the limiting reactant when 4.68 g of Fe reacts with 2.88 g of S to produce FeS.

$4.68\,g\,Fe \times \frac{1\,mol\,Fe}{55.9\,g} \times \frac{1\,mol\,S}{1\,mol\,Fe} \times \frac{32.1\,g}{1\,mol\,S} = 2.69\,g\,S$ needed (excess!)

Fe is L.R.

C) What mass of iron (II) sulfide, FeS, will be formed in the reaction?

$4.68\,g\,Fe \times \frac{1\,mol\,Fe}{55.9\,g} \times \frac{1\,mol\,FeS}{1\,mol\,Fe} \times \frac{88.0\,g}{1\,mol\,FeS} = 7.37\,g\,FeS$

D) What mass of the excess reagent will be left over / unused?

$2.88\,g - 2.69\,g$ used $= 0.19\,g\,S$ left

3) Use the following chemical equation: $Mg(OH)_2 + 2\,HCl \rightarrow MgCl_2 + 2\,H_2O$

A) Balance the equation.

B) Identify the limiting reactant when 5.87 g of $Mg(OH)_2$ reacts with 12.84 g of HCl to form $MgCl_2$.

$5.87\,g\,Mg(OH)_2 \times \frac{1\,mol}{58.3\,g} \times \frac{2\,mol\,HCl}{1\,mol\,Mg(OH)_2} \times \frac{36.5\,g}{1\,mol\,HCl} = 7.35\,g\,HCl$ needed (excess)

$Mg(OH)_2$ is L.R.

C) What mass of magnesium chloride, $MgCl_2$, will be formed in the reaction?

$5.87\,g\,Mg(OH)_2 \times \frac{1\,mol\,Mg(OH)_2}{58.3\,g} \times \frac{1\,mol\,MgCl_2}{1\,mol\,Mg(OH)_2} \times \frac{95.3\,g}{1\,mol\,MgCl_2} = 9.60\,g\,MgCl_2$

D) What mass of the excess reagent will be left over / unused?

$12.84\,g - 7.35\,g$ used $= 5.49\,g\,HCl$ left

Source: Chemistry: Connections to Our Changing World (Prentice-Hall) Ch 11 "Chem Eq'ns" supplement pp. 19-20

4) Use the following chemical equation: $2\,SO_2 + O_2 \rightarrow 2\,SO_3$

A) Balance the equation.

B) Identify the limiting reactant when 12.4 g of SO_2 reacts with 3.45 g of O_2.

$12.4\,g\,SO_2 \times \frac{1\,mol\,SO_2}{64.1\,g} \times \frac{1\,mol\,O_2}{2\,mol\,SO_2} \times \frac{32.0\,g}{1\,mol\,O_2} = 3.10\,g\,O_2$ needed (excess)

SO_2 is L.R.

C) What mass of sulfur trioxide, SO_3, will be formed in the reaction?

$12.4\,g\,SO_2 \times \frac{1\,mol\,SO_2}{64.1\,g} \times \frac{2\,mol\,SO_3}{2\,mol\,SO_2} \times \frac{80.1\,g}{1\,mol\,SO_3} = 15.5\,g\,SO_3$

D) What mass of the excess reagent will be left over / unused?

$3.45\,g - 3.10\,g$ used $= 0.35\,g\,O_2$ left

5) Use the following chemical equation: $H_2O + SO_3 \rightarrow H_2SO_4$

A) Balance the equation. ✓

B) Identify the limiting reactant when 6.58 g of SO_3 reacts with 1.64 g of H_2O.

$6.58\,g\,SO_3 \times \frac{1\,mol\,SO_3}{80.1\,g} \times \frac{1\,mol\,H_2O}{1\,mol\,SO_3} \times \frac{18.0\,g}{1\,mol\,H_2O} = 1.48\,g\,H_2O$ needed (excess)

L.R. is SO_3

C) What mass of sulfuric acid, H_2SO_4, will be formed in the reaction?

$6.58\,g\,SO_3 \times \frac{1\,mol\,SO_3}{80.1\,g} \times \frac{1\,mol\,H_2SO_4}{1\,mol\,SO_3} \times \frac{98.1\,g}{1\,mol\,H_2SO_4} = 8.06\,g\,H_2SO_4$

D) What mass of the excess reagent will be left over / unused?

$1.64\,g - 1.48\,g\,H_2O$ used $= 0.16\,g\,H_2O$ left

6) Use the following chemical equation: $Cd + S \rightarrow CdS$

A) Balance the equation. ✓

B) Identify the limiting reactant when 8.47 g of Cd reacts with 2.51 g of S.

$8.47\,g\,Cd \times \frac{1\,mol\,Cd}{112.4\,g} \times \frac{1\,mol\,S}{1\,mol\,Cd} \times \frac{32.1\,g}{1\,mol\,S} = 2.42\,g\,S$ needed (excess)

L.R. is Cd

C) What mass of cadmium sulfide, CdS, will be formed in the reaction?

$8.47\,g\,Cd \times \frac{1\,mol\,Cd}{112.4\,g} \times \frac{1\,mol\,CdS}{1\,mol\,Cd} \times \frac{144.5\,g}{1\,mol\,CdS} = 10.9\,g\,CdS$

D) What mass of the excess reagent will be left over / unused?

$2.51\,g\,S - 2.42\,g\,S$ used $= 0.09\,g\,S$ left

Source: Chemistry: Connections to Our Changing World (Prentice-Hall) Ch 11 "Chem Eq'ns" supplement pp. 19-20